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Volume 14 | Number 4 Article 5

10-1-1959

Why Do We Use "New Practices"?

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Why Do We Use "New Practices"?

Are new practices and techniques adopted simply because they're discovered and made available? "Not unless they're profitable," is the answer that research is giving. Here's an example based on the use of fertilizer in Iowa.

by Martin H. Yeh and Earl O. Heady

ONE OF THE biggest changes in agriculture over the past 25 years has been the growing use of nonfarm resources or inputs—materials or services obtained from nonfarm sources for use in farming. In fact, these "outside" inputs represent the major "new practices" or innovations which are being used to increase production per acre and total output.

Some innovations or "new practices" represent rearrangements within farming itself. Examples are the adoption of better rotations and livestock sanitation practices. But during the last 20 years, innovations or new practices have more generally meant buying materials or services from off the farm and putting them to work in agriculture.

Farm families have greatly increased their use of nonfarm resources and the practices which they represent. Examples are fertilizers, insecticides, machinery, fuel, oil, many kinds of seeds, etc. These are the types of inputs that have been very important in increasing production per man and total output from agriculture as well. These are the inputs which are substituting for much of the labor formerly used in farming.

Why Are They Used?

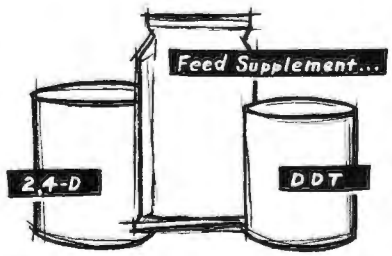
Why do farm operators use so many of these outside resources or off-the-farm inputs and the practices which they represent? Is the adoption of these practices dependent merely on their development and farm families obtaining knowledge, contact and experience with them? Knowledge and experience are important. But they're not the whole story—or probably not even the main reason for adopting the practices or using more of the nonfarm inputs. An important explanation lies in the price of these nonfarm resources relative to the price of farm products.

This is the story which our studies at Iowa State are beginning to confirm: Briefly, that these resources and the practices associated with them either would not be adopted or at least not used extensively unless they're found to be profitable!

Not only do these inputs substitute for labor, but they also substitute for land. By using more chemicals, steel and petroleum products, for example, we can increase yields per acre so that fewer acres are needed to produce the necessary food.

But remember, farm operators don't adopt new practices just because they learn about them or see someone else using them. They're adopted because they're profitable! The lower the price of the material or input relative to the price of the product which it produces, the more profitable it is to use. And the price of many of these inputs has declined relative to the price of farm products over the past 20 years.

All prices have gone up because of inflation. But some nonfarm inputs haven't gone up in price as rapidly as farm product prices. So, in effect, the *relative price* of of these inputs has gone *down*.



New resources and practices aren't used widely just because they're discovered. They're adopted extensively only after their use is found profitable.

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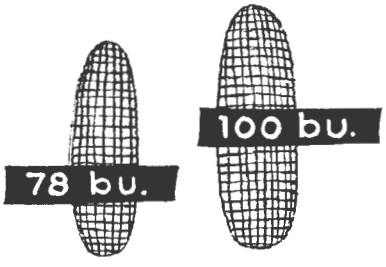
This means that it takes less farm production to pay for their use than in former times. Their use, thus, has been extremely profitable when they've also increased yields.

A good example to illustrate some of these effects is the use of fertilizer, though our studies of the demand and use of other "outside" resources are beginning to turn up similar answers also.

The Fertilizer Resource . . .

The amount of fertilizer which a given amount of crop would purchase almost doubled between 1926 and 1956. And between 1945 and 1955 alone, the use of all chemical fertilizers in Iowa increased by nearly 400 percent. For the individual major nutrients: use of nitrogen doubled, phosphorus tripled, and potassium increased sixfold.



A farm operator doesn't use fertilizer until he knows about it and something of the results he can expect from it.

Many factors or variables influence the amounts of fertilizer used by Iowa farm operators. One important thing is knowledge. A farm operator doesn't use fertilizer until he knows about it and something of the response he can get from it. But once knowledge is present, other factors determine how much fertilizer is used.

One of these is the capital and tenure position of the operator. Generally, operators with more limited funds and those on rented farms use less fertilizer than those with more capital and on their own farms. And use varies considerably on rented farms, depending on whether or not fertilizer costs are shared in the same proportions as the crops on which fertilizer might be used.

Three Main Factors . . .

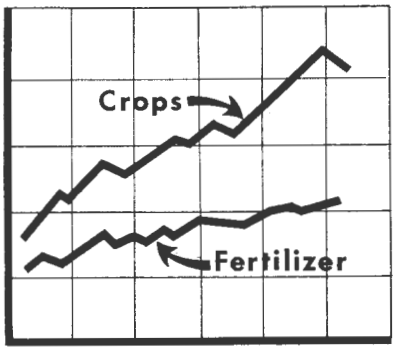
We found three other main variables related to the total amount of fertilizer used by Iowa farm operators. These three "explain" about 98 percent of the variation in total fertilizer use in the state over the past 30 years.

One of these factors is the amount of fertilizer used previously—in the year before. If we wished, for instance, merely to predict the total amount of fertilizer to be used next year, the best single clue is the amount used this year. But since neither individual farm operators nor all farmers in total use exactly the same amount of fertilizer every year, we have to look further to find what causes farmers in total to change fertilizer use from "usual amounts." The two main factors, here, are price relationships and knowledge as related to time.

The important price relationship in explaining fertilizer use in Iowa has been the ratio of fertilizer prices to crop prices. This ratio is figured by dividing the unit price of fertilizer by the unit price of crops. If fertilizer is selling at 10 cents per pound and corn at $1 per bushel, for example, the price ratio is $0.10/$1.00 = 0.10. If fertilizer is 15 cents and corn is $1, the ratio is 0.15, or if fertilizer is 12 cents and corn is 80 cents, the ratio also is 0.15.

Fertilizer use goes down as this ratio goes up. An increasing ratio means that it takes more of the crop to pay for a given amount of fertilizer. A drop in the ratio has the opposite effect. The ratio increases when the price of fertilizer goes up or when the price of crops goes down. It decreases when the fertilizer price decreases or when crop prices increase. It also increases when crop prices increase more rapidly than fertilizer prices—even though both may be increasing.

Over the past 20 years, crop



Except for the last few years, crop prices have gone up more rapidly or to higher levels than have fertilizer costs over a period of 20 years.

prices have gone up more rapidly, or to higher levels, than the cost of fertilizer. Fertilizer costs haven't gone up as rapidly as crop prices. This is largely because of technical and marketing improvements in the fertilizer industry.

Using 1940 as a base point, crop prices in the Corn Belt had risen 135 percent by 1950 and 156 percent by 1955. In contrast, fertilizer prices had risen only 47 percent by 1950 and 56 percent by 1955. Crop prices, however, have fallen relative to fertilizer prices in the last few years.

How Much Effect . . .

How much effect do these changes have on fertilizer use? Our study has revealed that, in the last 30 years, there has been a close relationship between these changes and fertilizer use.

A 1-percent change in the fertilizer-crop price ratio has been associated with a 0.68-percent change in total fertilizer use in the short run—that is, between years. If the price ratio increases by 1 percent because the fertilizer price goes up or the crop price goes down, fertilizer use can be predicted to drop by about 0.68 percent. Likewise, from a drop of 1 percent in the price ratio, an increase of about 0.68 percent in fertilizer use can be predicted, though knowledge and other factors related to time may partly offset these changes.

The figure for nitrogen alone is much greater in the short run. A

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change in the price ratio of 1 percent has been associated with a change of 1.01 percent in the use of nitrogen. The corresponding figure for potash is only 0.41 percent.

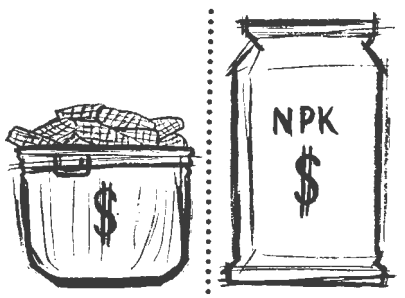
These figures apply only to the short run. Over the long run—a long enough time for farm operators to make adjustments in decisions and farm organization—a 1-percent change in the fertilizer-crop price ratio is associated with about a 5-percent change in the use of all fertilizer. The comparable figures for individual nutrients are 9 percent for nitrogen and about 2½ percent for phosphorus and potassium.

All of these figures, however, are based on the past 30 years—a period when the long-run tendencies were for lower relative prices of fertilizer and increased knowledge about fertilizer returns. So the figures may be too optimistic to apply to the future, particularly from the standpoint of increased fertilizer use.

Knowledge of fertilizer and other forces related to time also have their effects. We couldn't measure the effects of all of these forces individually. But as a group, their influence was always toward an increased use of fertilizer—averaging slightly less than an increase of ¼ percent per year in the short run. The figure is greater for the long run, amounting to about a ½-percent change with a 1-percent change in time, knowledge or the other factors, except the price changes already discussed.

The Relative Effect . . .

The *single most important* variable affecting fertilizer use in Iowa over the next 10 years most likely will be *the price of crops and the price of fertilizer compared with each other.* Increased knowledge of fertilizer responses will also tend to increase fertilizer use, but the relative effect of prices will be greater.



The relationship between crop prices and fertilizer costs is an important factor affecting the use of fertilizer.

If, for example, support prices on crops were lowered substantially and if fertilizer prices remained the same, use of fertilizer would probably decline. Our analysis indicates that, if corn were allowed to fall to 80 cents per bushel in 1959 (and the prices of all other crops fell accordingly), total fertilizer use by 1960 would fall by about 10 percent from that actually used in 1958 — or from about 604,000 tons in 1958 to 540,000 tons in 1960. Use of nitrogen could be expected to decline by 21 percent, and potash, by 11 percent.

Such changes, of course, would be quite drastic and aren't likely to occur. But these are the types of changes that could be expected in fertilizer use under such price conditions.

Other Factors?

We're also exploring certain other factors important in determining the amount of fertilizer and other resources used by individual farm operators. Since farms aren't operated with unlimited capital, the amount of fertilizer that's most profitable depends also on the prices of materials used for other enterprises and the prices received for their products. For example, an operator with limited funds can make money in shifting capital from fertilizer to hogs if the price of hogs increases at the same time that the price of fertilizer increases. If, on the other hand, both of these prices decline, he can increase his returns by shifting funds from hogs to fertilizer.

One of the things we're attempting to learn in further studies is how large these relative price changes must be to have a meaningful effect on the use of fertilizer and other purchased-off-the-farm inputs. Eventually we hope to learn the effects of different pricing structures on the total quantity of such inputs used in farming and the relation of these inputs to the total output of agriculture. From these it also may be possible to predict how these inputs may affect the amount of labor and land needed in the future to produce the nation's food requirements.